REPORT RESUMES

ED 013 755 SE 001 722

A SUGGESTED CHECKLIST FOR ASSESSING A SCIENCE PROGRAM.
OFFICE OF EDUCATION, WASHINGTON, D.C.
REPORT NUMBER OE-29034-A PUB DATE JAN 64
EDRS PRICE MF-$0.25 HC-$0.92 23P.

DESCRIPTORS- *CURRICULUM EVALUATION, *CURRICULUM, *ELEMENTARY SCHOOL SCIENCE, *EVALUATION, *EVALUATION TECHNIQUES, *PROGRAM EVALUATION, *SECONDARY SCHOOL SCIENCE, UNITED STATES OFFICE OF EDUCATION, SELECTED SCIENCE SERVICES,

SUGGESTIONS AND A CHECKLIST FOR THE EVALUATION OF ELEMENTARY AND SECONDARY SCHOOL SCIENCE PROGRAMS ARE CONTAINED IN THIS UNITED STATES OFFICE OF EDUCATION BULLETIN. AN INTRODUCTORY SECTION DEALS WITH THE IMPORTANCE OF (1) BROAD FACULTY PARTICIPATION, AND (2) UP-TO-DATE CONTENT AND METHODS IN PROGRAM EVALUATION. EXPLANATIONS FOR THE CONSTRUCTION AND USE OF A PROGRAM PROFILE AND THE USE OF THE CHECKLIST ARE ALSO PROVIDED. THE INSTRUMENT IS SUBDIVIDED INTO 10 SECTIONS EACH CONTAINING PERTINENT QUESTIONS. SUBDIVISIONS INCLUDE--(1) THE FOUNDATIONS FOR LOCAL PROGRAM PLANNING, (2) PUBLIC RESPONSIBILITY AND GOALS, (3) CURRICULUM, (4) TEACHING-LEARNING, (5) EVALUATION, (6) YOUTH ACTIVITIES, (7) STAFF CHARACTERISTICS, (8) PROGRAM ADMINISTRATION, (9) FINANCIAL ARRANGEMENTS, AND (10) FACILITIES, EQUIPMENT, AND TEACHING AIDS. A THREE-POINT RATING SCALE AND A FORM FOR THE DEVELOPMENT OF A COMPOSITE PROFILE ARE INCLUDED. THIS DOCUMENT IS ALSO AVAILABLE FOR $0.15 FROM THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C. 20402. (AG)

RESEARCH
YOUTH ACTIVITIES
INSTRUCTION
SUPERVISION
CONSULTATION
PUBLICATIONS
SELECTED SCIENCE SERVICES
PHYSICS
GENERAL SCIENCE
AERO-SPACE SCIENCE
CHEI
EARTH SCIENCE

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE • Office of Education

January 1964 (Revised)

AIDS FOR TEACHING SCIENCE

A Suggested Checklist for Assessing A Science Program

Adapted by the Specialists for Science
Bureau of Educational Research and Development

Many persons in all parts of the country are concerned about the quality of their schools. Taxpayers want to know whether their tax dollars are well spent. Administrators want to know what they can do to strengthen their school programs, and conscientious teachers and supervisors want to know how well they are doing in light of present efforts to improve teaching.

How to go about assessing a school program is a problem, particularly in science where content and methods are changing rapidly--perhaps even more so than in other subjects.

To evaluate a program some kind of yardstick is needed. This publication contains a suggested checklist that can help identify the strong points of a science program as well as those that need to be strengthened. The checklist may be used at all levels, in schools of varying sizes, and by teachers of varying degrees of experience. Therefore, the following suggestions on the use of the list are not all applicable to every situation. Many have come from individual teachers and supervisors and have been found useful by them; and there are, among the suggestions, some which will be of use to any school undertaking an evaluation of its science program.

This service bulletin has been prepared by the U.S. Office of Education at the request of many schools. This fifth revision, which results from extensive field use over the past several years, has been submitted to competent specialists of science, professors of science education, science teachers, and others for comments and editorial suggestions. We wish to thank all who have had a part in making this checklist an improved instrument for the evaluation of a science program.

Broad Participation

The broader the participation of science teachers, supervisors, principals, and superintendents in the science program evaluation, the more satisfactory the results. To initiate it, each science teacher of a given school might fill out a copy of the suggested checklist. Then all the science teachers in each school of the district or system might, as a group (again using the checklist), evaluate their particular school's science program and prepare a composite checklist. Finally, the proper authorities could, in the same way, evaluate the science program of the entire school system. From the evaluations, a profile would emerge of the school system's strengths and weaknesses in science teaching. This profile would be the basis for setting up priorities in a plan to improve the science program.

Recency of Content and Methods

When using a checklist keep in mind the importance of recency. For example, a library collection in science cannot be considered up to date if few of the books, especially in rapidly developing science areas, have been published within the past 5 years. Similarly, a teacher's science background should be modern. Unless it has been updated by science refresher courses or independent study during the last few years, it too is out of date.

Teaching methods for science should be as modern as the content itself. It goes almost without saying these days that how children and young people learn is as important, really, as what they learn. Who would gainsay that they must be equipped to find answers to problems as well as to manipulate verbal and mathematical symbols in the three R's?

Merely to memorize facts is no longer considered sufficient in education. It has become increasingly clear that the apparent validity of a fact cannot be assured for any given length of time. But scientific methods of inquiry into the nature of things will stand the test of time and are as necessary in other areas of learning as they are in science.

In good science programs, pupils do not use the laboratory merely to confirm textbook statements or to follow step-by-step written procedures. Rather, they participate in activities that stimulate scientific creativity in identifying problems, stating hypotheses, designing experiments, and evaluating data from many sources. Open-end activities, where the pupil can continue an individual investigation in greater depth, have been designed for both elementary and secondary grades; and reports concerning them have been published. In science many resourceful teachers use pupil-teacher planning to develop their own unique investigative experiments.

A Profile for Determining Priorities

Everything cannot be done at once -- outline a science curriculum for junior high school, develop an inservice education program for elementary teachers, plan a program for academically talented senior high school students, provide individual laboratory work in general science, and arrange a science fair. Confronted by all these urgent problems, decide which ones in your own school are most crucial. How to decide?

One help in deciding might well come from making an evaluation profile from the data provided from this checklist of the science program. At the end of this publication is a suggested chart for such a profile which ties in with the immediately preceding suggested checklist. When the profile chart is filled in from the answers appearing on the checklists, it will become apparent which science-program problems are most crucial and pressing. These problems would naturally be given top priority and, as such, could then serve as the starting point to plan improvements in the program.

How To Use the Checklist

The checklist items are merely suggestions. Many of the items are general statements because local school systems vary greatly. A school may want to revise them to fit local needs. In any case, it would want to examine each item--as it now stands or after revision--to make certain that when the entire list is applied to the local program it does in fact draw an accurate profile of that program.

More specific checklists will be required for followup use after this general checklist has been completed by the local schools. Such checklists will be available soon from the U.S. Office of Education for elementary school science, junior high school science, and senior high school sciences (biology, chemistry, and physics). These will search more intensively and more deeply into items which pertain especially to the levels mentioned above.

The checklist is provided with four answer columns, which may be used as suggested below, or the individual schools can write in their own headings, geared to local requirements.

Check (✓) the column most applicable:

3--There is much evidence that the practice exists
2--There is some evidence that the practice exists
1--There is little evidence that the practice exists
Insert 0 in column headed "other" if the item does not exist
Insert X in column headed "other" if the item does not apply

	3	2	1	other
1. (Item)				
2. (Item)				
3. (Item)				
etc.				

An alternate method of using the checklist is to place a check in one of the first three columns that answers the item as in 1, 2, or 3 below.

3--Yes, there is much evidence that the practice exists
2--Yes, there is some evidence that the practice exists
1--No, there is no evidence that the practice exists

A SUGGESTED CHECKLIST FOR ASSESSING A SCIENCE PROGRAM [1]

The items marked with an asterisk (*) may be considered as being of major importance or most desirable for a minimum basic science program. If a school wishes to change or add to these basic items, it may do so.

I. FOUNDATIONS FOR LOCAL PROGRAM PLANNING

	3	2	1	other
*1. Has a local science advisory committee been established?				
*2. Have such representatives of the local community as scientists, engineers, school and lay personnel been involved--to the extent of action--on the local advisory committee?				
3. Has a survey or a listing been made of local science-related resources available for improving science teaching?				

[1] Adapted by permission. School Management Magazine, Inc., copyright 1959.

	3	2	1	other
4. Have resources of local business and industry been utilized, e.g., field trips, classroom presentations, and science materials?				
5. Are scientists from the local area <u>regularly</u> invited to participate in the school's science program?				
6. Are scientists and science educators from nearby colleges and universities invited to serve as consultants and speakers for the school's science program?				
*7. Are measurements made of factors such as changes in enrollment and interest in science classes and activities which might be significant in planning for facilities, staff, budget, and curriculum?				
*8. Is there coordination to insure that conservation, health, safety, aerospace, and other like areas are being adequately included in the science program and at the same time are not being duplicated?				
*9. Is attention being given to coordinating the science program with the mathematics, English, social studies, and other programs?				
10. Is there provision for two-way communication between the community and school about changes in the science program, whether through the advisory committee or by some other means?				
11. Has an effort been made to develop adjunct science activities within the community, such as a junior museum, nature trail, or wildlife preserve?				

II. <u>PUBLIC RESPONSIBILITY AND GOALS</u>

*1. Has the local board of education and the school administration evidenced a sensitivity for the responsibility for public education in science:

	3	2	1	other
a. By establishing policies which are consistent with local, State, and national needs, such as providing for an education adequate to give the background needed for future scientists, engineers, technicians, and scientifically oriented nonscience citizens?				

3 2 1 other

b. By providing an opportunity for every child to study science at every grade level?

c. By providing for the identification, encouragement, and development of boys and girls with special science talent?

d. By considering the need for a science program for students with below-average ability?

e. By recognizing that specific facilities and equipment as well as properly trained science teachers are a basic requisite to a good program, and by making plans to adequately finance such a program?

*2. Have consistent long-range goals in harmony with the present American culture (as implied in the preceding statements) been established for your science program?

*3. Do long-range goals give emphasis to the processes of scientific inquiry, e.g., problem recognition, assumption recognition, hypothesizing, observations as comparison and measurement, experimental design and conduct, data analysis and interpretation, and the extension and relating of understandings to new problems?

4. Are the long-range goals for the science program used in determining short-range immediate objectives?

5. Has competent outside professional guidance, both educational and scientific, been sought in the development of the long-range goals for your science program?

6. Do the long-range goals consider the nature and importance of the history, philosophy, and lives of men of science as a major cultural influence?

III. CURRICULUM

*1. Does the content of science courses taught provide a valid impression of science as it exists today both in terms of major ideas and the evidence upon which these ideas are based?

*2. Have criteria, based on long-range goals, been established for the selection and organization of course content?

	3	2	1	other
3. Are broad integrating themes used as the basis for developing an understanding of science?				
*4. Is science scheduled as a regular subject and is it available to each pupil at every grade level?				
*5. Is the amount of class time scheduled for science at every grade level sufficient for the full attainment of the desired goals?				
*6. Are open-ended and problem-solving-type activities used extensively as a means of developing:				
a. Scientific attitudes?				
b. Skills in the processes of scientific inquiry?				
c. Functional understandings of scientific concepts?				
*7. Do science courses provide frequent opportunities for each pupil to engage in laboratory work and other firsthand experiences?				
8. Are double laboratory periods or extended class time scheduled each week for the science courses offered in grades 7 to 12?				
9. Are the school's science laboratories and/or project work areas available to science talented pupils for independent projects and research outside of regular class time?				
10. Are the pupils who have shown interest in science careers provided opportunities to take at least 4 years each of science and mathematics in grades 9 to 12?				
11. Is every secondary school pupil required to take a minimum of 2 years of laboratory science, at least 1 each of biological and physical science, for graduation?				
*12. Does the curriculum at all grade levels give emphasis to the historical, biographical (men of science), and philosophical aspects of science?				
13. Have the following been utilized in the development of science curriculum materials:				
a. State department of education personnel?				
b. Science supervisors?				
c. Local teaching and administrative staff?				

3 2 1 other

d. College and university scientists and science educators?

e. Business and industry personnel?

f. Representatives of lay organizations, e.g., county farm agents, health department, hospital, and clinic personnel?

14. Is there a trend in curriculum revision in your school to cover fewer topics (subject matter areas)? Are those areas that are selected for study covered in greater depth?

IV. TEACHING-LEARNING

*1. Are pupils at all levels given opportunities to:

a. Learn and practice skills in scientific observation?

b. Design, set up, and carry out controlled experiments to test hypotheses?

c. Formulate and delimit problems?

d. Recognize assumptions?

e. Prepare and discuss hypotheses regarding the solutions to problems?

f. Use appropriate instruments for making measurements?

g. Use proper statistical and mathematical procedures for handling measurements?

h. Evaluate and interpret evidence they have collected?

i. Learn the value of withholding judgment until sufficient evidence has been collected?

j. Recognize the nature of any conclusion and modify this conclusion on the basis of new evidence?

*2. Do pupils at all levels have the opportunity to discover science principles through participation in experiences rather than through mere reading or talking about science?

	3	2	1	other
*3. Does the laboratory work consist of working on real problems which are genuinely thought-provoking rather than performing "cookbook" types of exercises?				
4. Are teacher and pupil-teacher demonstrations used to promote critical thought and discussion rather than just to serve as illustrations of science principles?				
*5. Are pupils encouraged to question evidence, challenge loose thinking, and develop hypotheses as an accepted part of classroom behavior?				
6. Do science activities seek to relate new learnings to previous learnings?				
7. Are pupils encouraged to develop investigations on their own?				
V. EVALUATION Evaluation of Pupil Performance *1. Does the evaluation program make use of a variety of techniques and instruments such as the following: a. Anecdotal records?				
b. Performance tests?				
c. Objective tests?				
d. Essay examinations?				
e. Observations of laboratory procedures?				
f. Rating scales?				
2. Are inservice or other opportunities available for teachers to discuss and prepare evaluation materials and procedures?				
Evaluation of the Science Program *1. Are criteria for evaluation available which are based on the stated goals for the science program?				
2. Are materials (books, sample tests, and national norms) available within the school to help teachers evaluate pupil learnings in science?				

	3	2	1	other
*3. Is there specific evidence that attempts are made at all grade levels to evaluate growth in the processes of scientific inquiry?				
4. Are efforts made to follow up the graduates of high school to determine whether or not the science program has met the needs of:				
a. Those who plan to follow careers in science?				
b. Those who plan to become science teachers?				
c. Those who plan to become science technicians?				
d. Those who do not plan to pursue science-related careers but who will become scientifically literate citizens?				
*5. Are teachers encouraged and given the opportunity to evaluate their own teaching procedures?				

VI. YOUTH ACTIVITIES

	3	2	1	other
*1. Does your school science program include one or more of the following:				
a. Science clubs?				
b. Science seminars?				
c. Annual science exhibits?				
d. Participation in a statewide or national organization?				
e. Participation in the Junior Academy of Science?				
f. The Westinghouse Science Talent Search?				
2. Do the secondary school science pupils conduct research projects which may be exhibited at science fairs or science congresses?				
3. Do pupils prepare and read scientific and research papers at science congresses, junior academies of science, and other scientific meetings?				

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	3	2	1	other
*4. Do projects for science students emerge from and, in part, contribute to the on-going classroom activities?				
5. Are the science youth organizations affiliated with:				
a. Local organizations?				
b. State organizations?				
c. National organizations?				
6. Are the faculty sponsors of science youth activities given either compensatory time or a salary supplement?				
7. Are science pupils encouraged to participate in:				
a. Summer science camps?				
b. Summer science institutes?				
c. Summer science expeditions?				
d. Summer employment in scientific laboratories?				
STAFF *1. Are the NASDTEC-AAAS[2/] recommendations for preparation in science and mathematics met by a substantial portion of:				
a. Elementary school teachers?				
b. Junior high school science teachers?				
c. Senior high school science teachers?				

2/ Guidelines for Science and Mathematics in the Preparation Program of Elementary School Teachers, National Association of State Directors of Teacher Education and Certification in Cooperation with the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW., Washington, D.C., 1963.

Guidelines for Preparation Programs of Teachers of Secondary School Science and Mathematics, National Association of State Directors of Teacher Education and Certification in Cooperation with the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW., Washington, D.C., 1961.

	3	2	1	other
*2. Have all science teachers completed at least:				
a. An undergraduate major in a science?				
b. A master's degree in science?				
3. Are inservice institutes conducted for science teachers as a regular part of their professional workload?				
4. Have most of the science teachers attended summer or academic year science institutes within the last 5 years?				
*5. Is consultant help available to all science teachers from:				
a. An elementary science consultant?				
b. A secondary science consultant?				
c. Scientists in local industry?				
d. Scientists and science educators in a nearby college or university?				
e. A State supervisor of science?				
f. Academies of science?				
*6. Do science teachers generally attend meetings of professional or scientific organizations at the:				
a. Local level?				
b. State level?				
c. Regional level?				
d. National level?				
7. During out-of-school time do all science teachers strive to improve their professional, scientific, and general cultural backgrounds through:				
a. Travel?				
b. Study?				
c. Work in science-based industry?				
d. Engaging in scientific research?				
e. Engaging in science education research?				

	3	2	1	other
8. Do all the science teachers subscribe to or read:				
a. Educational journals?				
b. Scientific journals?				
c. Journals of research in science teaching?				
d. Science teaching journals?				
9. Are science teachers given assistance by means of one or more of the following:				
a. Clerical help?				
b. Paid laboratory assistants?				
c. Volunteer laboratory assistants?				
d. Free periods for planning activiti and caring for and setting up equipment?				
10. Does the guidance staff include conselors who are sensitive to the needs of pupils interested in science?				
*11. Do science teachers assume professional responsibility for career guidance of pupils interested in science?				
12. Do science teachers work with other staff members to effectively coordinate teaching-learning activities?				
13. Do science teachers assist pupils or refer them to appropriate personnel for assistance in the improvement of reading and study skills?				
VIII. ADMINISTRATION				
*1. Do the board of education and the administration have a policy to frequently review teacher assignments in terms of academic and other qualifications?				
*2. Have the board of education and the school administration taken specific action to enable and encourage teachers to update their:				
a. Professional qualifications?				
b. Academic qualifications?				

	3	2	1	other
3. Are teachers on all grade levels encouraged to experiment with new content and new techniques?				
4. Are science teachers allowed time with pay to attend professional conferences related to the science program?				
5. Does the school have a policy that provides for, encourages, and regulates:				
a. Local field trips?				
b. School journeys to special areas?				
c. Summer excursions for scientific studies?				
*6. Does the administration exert leadership to encourage science teachers and other teachers to work together for overall science program planning as part of their regular assignment?				
7. Does the administration maintain close contact with and seek consultant help from the school district and State supervisors of science?				
*8. Does the administration recognize that good science teaching requires more in the way of specific facilities and equipment than other academic areas and that science classes should not be scheduled in standard classrooms?				
9. Does the school district provide transportation for science field trips for:				
a. Science pupils?				
b. Science teachers?				
IX. FINANCES				
*1. Does the budget[3] provide realistically and adequately for science:				
a. Apparatus?				
b. Supplies?				

3/ Charles L. Koelsche and Archie N. Solberg, Facilities and Equipment Available for Teaching Science in Public High Schools, 1958-59. Toledo, Ohio: Research Foundation, University of Toledo, 1959, p. 26.

"...(a) breakdown of budgeted funds for the various enrollment categories revealed that the average amount per science student in the 1-199 size group was $3.90; 200-499, $2.88; 500-999, $2.50; and 1000-up, $2.26."

3 2 1 other

c. Instructional material?

d. Teaching aids?

e. Library books?

f. Repair, maintenance, and replacement of equipment and materials?

2. Is science equipment purchased with the needs of specific science courses in mind?

3. Does the school science budget provide needed laboratory supplies for each student in every course throughout the year?

4. Is a petty cash fund or an equivalent source of money provided to purchase incidental science materials?

*5. Does the salary structure:

a. Attract well-qualified science teachers?

b. Include increments which will assure retention of well-qualified teachers?

c. Eliminate the need for additional nonprofessional employment?

6. Does the school provide money and/or leave for professional travel for science teachers?

7. Have NDEA Title III funds been used to the limit of Federal matching funds?

8. Are science teachers consulted in the establishment of budgetary procedures and the formulation of the budget?

X. FACILITIES, EQUIPMENT, AND TEACHING AIDS

*1. Are the suggestions and recommendations of qualified science teaching personnel sought and incorporated in plans for new science facilities?

*2. Does each room where science is taught have the following characteristics:

a. Proper heat and ventilation (including fume hoods where needed)?

	3	2	1	other
b. Good lighting with supplementary lighting where needed?				
c. Electrical wiring and outlets with voltage and amperage control where needed?				
d. Gas supply and outlets where needed?				
e. Running water taps and sinks where needed?				
f. Proper acoustics for potentially noisy areas?				
g. Room darkening facilities (blackout shades)?				
h. Area suitable for photographic darkroom work?				
i. Exhibit and display areas?				
j. Space for individual pupil project work?				
k. Suitable areas for maintaining living plants and animals near or in the biology laboratory?				
l. Acid resistant tabletop and floor covering where needed?				
m. Preparation area?				
3. Are the following laboratory safeguards provided: a. Prevention and control of gas, chemical, and electrical fires (blankets or extinguishers)?				
b. Electrical equipment (fuses, breakers, etc.)?				
c. Emergency shower and eye fountains?				
d. "Hot lab" facilities for radioactive chemicals?				
e. First aid kits or cabinets?				
f. Properly placed exits?				

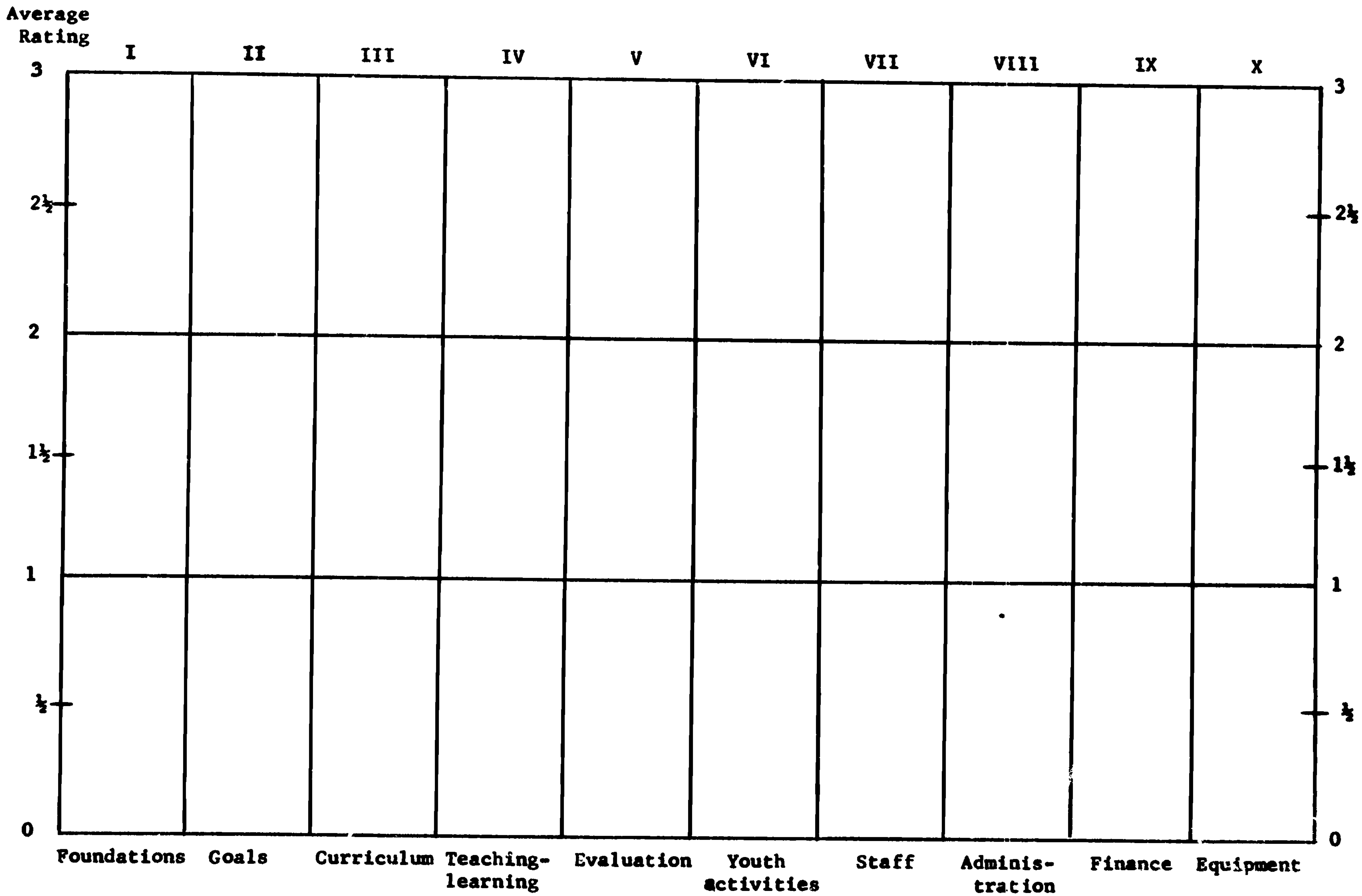
	3	2	1	other
4. Are the science facilities, furniture, and equipment suitable for and adaptable to:				
a. Individual experimentation by pupils?				
b. Long-term pupil experiments or projects?				
c. Teacher and pupil demonstrations?				
d. Small and large group work?				
e. Effective use of supplementary aids?				
f. Science clubs, fairs, and project activities?				
5. Does each science teacher have facilities for effective performance of:				
a. Preparatory activities?				
b. Conference activities with pupils and parents?				
c. The use of reference books and materials?				
d. Desk and office functions?				
6. Are adequate storage facilities provided in:				
a. The rooms where science is taught?				
b. Separate storage and/or preparation rooms?				
7. Are equipment and supplies stored and organized for effective use in:				
a. Classrooms and laboratories?				
b. Storage facilities?				
8. Are adequate inventory records and controls maintained for science equipment and materials?				
9. Are the science rooms equipped with the following instructional aids or are they readily available:				
a. Overhead projector?				
b. Microprojector?				
c. 16 mm. movie projector?				

	3	2	1	other
d. Slide and filmstrip projector?				
e. Closed circuit television?				
f. Programed learning devices?				
*10. Are suitable[4/] types of basic equipment and instructional aids provided for and readily available to:				
a. Teachers for instructional purposes?				
b. Pupils for project work?				
c. Pupils for team work?				
d. Pupils for individual work, both during and outside of classroom time?				
*11. Are adequate[4/] quantities provided of the following:				
a. Textbooks with recent copyright dates?				
b. Science periodicals for teachers?				
c. Science periodicals for pupils?				
d. Science reference books for teachers?				
e. Science reference books for pupils?				
f. Professional science journals?				
12. Are the following types of facilities available in areas where possible:				
a. A school pond or wild life area?				
b. An area where activities related to conservation may be carried out?				
c. A greenhouse?				
d. A weather station?				
e. A planetarium?				
f. An area where the environmental conditions--temperature, light, and moisture--can be controlled and varied?				

4/ Should be interpreted as meaning sufficient for the full realization of the purposes and goals of the course.

	3	2	1	other
*13. Is the library adequately equipped with books for a comprehensive science program?				
14. Does the science staff request additional titles to supplement existing references?				
15. Is the library effectively and regularly used by the: a. Pupils?				
b. Science teachers?				

EVALUATION PROFILE



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UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

First Printed 1962
Reprinted 1963
Revised 1964

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1964

For sale by the Superintendent of Documents,
U.S. Government Printing Office,
Washington, D.C., 20402 - Price 15 cents.